

CLAIMS

I/we claim:

1. In a probe for insertion into molten metal to detect and measure particulates suspended therein using the electric sensing zone method, the probe comprising:

5 a sealed inner tube of an electrically insulative material forming a molten metal receiving chamber, the tube including at least one orifice proximate an insertion end of the probe to permit molten metal to flow into the chamber;

a gas passageway extending out of the inner tube for connection to a vacuum source to create a pressure differential between the inside and outside of the inner tube for facilitating the flow of molten metal through the at least one orifice;

10 a first electrode extending into the chamber for engaging metal within the chamber, the first electrode including the gas passageway and at least one first elongate member having a first length and electrically connected to the gas passageway;

15 a second electrode surrounding at least a portion of the inner tube for engaging molten metal outside of the chamber, the first and second electrodes being connectable to a measurement device for establishing a current path through the electrodes and passing through the at least one orifice and for measuring changes in the electrical potential between the electrodes produced by the passage of particulates entrained in the molten metal passing through the orifice;

an outer sheath of heat resistant material surrounding at least a portion of the second electrode to provide thermal insulation therefor;

20 a liquidus depressing material within the chamber for alloying with molten metal entering the chamber to lower the liquidus temperature of the molten metal in the chamber and permit a longer time period for detecting and measuring particulates in the molten metal,

an improvement comprising:

25 at least one second elongate member electrically connected to the gas passageway at a first end of the at least one second member and extending into the chamber for engaging metal within the chamber; and

a chill block attached to a second end of the at least one second member, the at least one second member having a second length such that the chill block is spaced from the liquidus depressing material.

5 2. The probe of claim 1 wherein the second length is shorter than the first length.

3. The probe of claim 1 wherein the gas passageway extends less than half-way along the length of the inner tube.

10 4. The probe of claim 1 wherein the at least one first member is connected to a distal end of the gas passageway.

5. The probe of claim 1 wherein the gas passageway is initially connected to a source of purge gas for causing purge gas to flow into the chamber, at least during insertion of the probe into the
15 molten metal, to prevent molten metal from flowing into the chamber.

6. The probe of claim 5 further comprising a valve for connecting the gas passageway to either the vacuum source or the purge gas source.
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7. The probe of claim 1 wherein the gas passageway extends into the inner tube by a predetermined distance to establish the amount of metal which may enter the chamber.

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8. The probe of claim 1 wherein the first electrode comprises the gas passageway, at least one first wire extending from the gas passageway and into the chamber and at least one second wire extending from the gas passageway and into the chamber.

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9. The probe of claim 1 wherein the inner dimension of the second electrode is greater than the outer dimension of the inner tube to create an annular space there between.

10 10. The probe of claim 9 further comprising a spacer member positioned within the annular space proximate the insertion end of the second electrode.

11. A method for detecting and measuring particulates suspended in molten metal using a probe including a sealed inner tube of electrically insulated material for establishing a receiving chamber, the tube including an orifice to permit molten metal to flow into the chamber, a first electrode extending into the chamber for engaging molten metal within the chamber, a second electrode surrounding at least a portion of the inner tube for engaging molten metal outside of the chamber, an outer sheath of heat resistant material surrounding at least a portion of the second electrode to provide thermal insulation therefor, and a gas passageway extending out of the inner tube, the method comprising the steps of

installing a liquidus depressing material within the chamber;

connecting a chill block to the first electrode;

connecting the first and second electrodes to a measurement device, wherein the first electrode includes the gas passageway, at least one first wire extending from the gas passageway and into the chamber and at least one second wire extending from the gas passageway and into the chamber, the at least one second wire being shorter than the at least one first wire, the chill block being attached to the at least one second wire;

connecting the gas passageway to a vacuum source;

installing the probe in molten metal such that molten metal flows through the orifice and into the chamber;

the measurement device establishing a current path through the electrodes and passing through the orifice; and

- 5 measuring changes in the electrical potential between the electrodes produced by the passage of particulates entrained in the molten metal passing through the orifice.